$$p=\frac{\frac{1}{n}\log 2-\log(2^{1/n}-1)}{\log n-\log(n-1)}.$$

For $n=2$, $p=1.75+$, hence two drawings must be made; for $n=6$, $p=12.15+$; hence, thirteen drawings must be made.

Also solved with the same result by F. O. Whitlock, and by a different method, which seems to me to be incorrect, by S. A. Corey, Hiteman, Iowa. The problem is equivalent to that of Problem IX, page 52, of Meyer's *Wahrscheinlichkeitsrechnung*. F.

MISCELLANEOUS.

146. Proposed by F. P. MATZ, Ph. D., Sc. D., Reading, Pa.

The year 1905 *began*, and will *end*, on a Sunday. Prove that this can not occur again until the year 2015.

Solution by WILLIAM HOOVER, Ph. D., Athens, Ohio.

The Dominical Letter for Sunday when on January 1 is A, and also when on December 31, the year being common. Those common years in the present century fulfilling the required conditions must have A for their Dominical Letter; such years are 1905, 1911, 1922, 1933, 1939, 1950, 1961, 1967, 1978, 1989, 1995, sufficient to show that the statement in the problem is not true.

REMARK BY PROPOSER. The year 2015 will begin on a Thursday.
Also solved by A. H. Holmes, Henry Heaton, G. B. M. Zerr, and G. W. Greenwood.

147. Proposed by F. P. MATZ, Sc. D., Ph. D., Reading, Pa.

If an *unknown* curve be described under a constant acceleration not tending to the center and the hodograph is a cardioid, what is the unknown curve?

I. Solution by WILLIAM HOOVER, Ph. D., Athens, Ohio.

Let r and p be the radius vector and perpendicular upon the tangent to the curve at the outer extremity of r and r'; p' the analogous lines in the hodograph, and h the double area generated by r in a unit of time.

Then by the theory of the hodograph,

$$r'=\frac{h}{p} \text{ .... } (1),\quad p'=\frac{h}{r} \text{ .... } (2).$$

Also, from the theory of central forces,

$$k=\frac{h^2}{p^3}\frac{dp}{dr} \text{ .... } (3),$$

and for the cardioid,

$$p'^2=\frac{r'^3}{2a} \text{ .... } (4).$$

Substituting r' and p' from (1) and (2) in (4),

$$h=\frac{2ap^3}{r^2}\text{.........}(5).$$

Then (5) in (3), gives

$$kr^4dr=4a^2p^2dp\text{.........}(6),$$

the differential equation to the required orbit.

Integrating (6), and supposing r and p to vanish together,

$$\frac{k}{5}r^5=a^2p^4\text{.........}(7),$$

the required orbit.

II. **Solution by G. W. GREENWOOD, M. A., Professor of Mathematics, McKendree College, Lebanon, Ill.**

Let the equation to the hodograph be $r=2a\cos^2\frac{1}{2}\theta$. Since the acceleration in the original curve is constant the velocity of the point in the hodograph is constant, and $s=4akt$, where k is some constant; that is $kt=\sin\frac{1}{2}\theta$.

From the equation to the hodograph we have $v=2a\cos^2\frac{1}{2}\psi$, where v is the velocity in the orbit and ψ is the inclination of the tangent at that point to the initial line.

$$\therefore \frac{ds}{dt}=2a\cos^2\tfrac{1}{2}\psi=2a(1-k^2t^2).$$

$$\therefore s=2a(t-\tfrac{1}{3}k^2t^3);\ i.\ e.,\ s=\frac{2a}{k}(\sin\tfrac{1}{2}\psi-\tfrac{1}{3}\sin^3\tfrac{1}{2}\psi),$$

which is the intrinsic equation to the orbit.

Also solved by G. B. M. Zerr, S. A. Corey, and the Proposer.

PROBLEMS FOR SOLUTION.

ALGEBRA.

234. Proposed by G. W. GREENWOOD, M. A. (Oxon), Professor of Mathematics and Astronomy, McKendree College, Lebanon, Ill.

Prove that $(x+n)^n-n(x+n-1)^n+\frac{n(n-1)}{2!}(x+n-2)^n-+\text{.........}=n!$

235. Proposed by WILLIAM HOOVER, Ph. D., Athens, Ohio.

Easter Sunday, 1905, was on April 23. How often in the last one hundred years has this occurred, and when?